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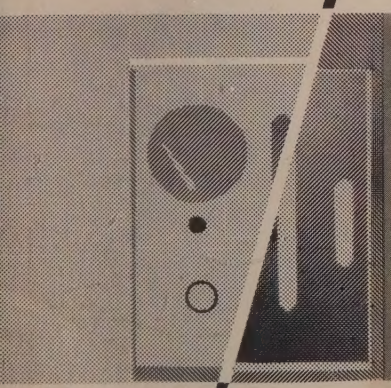
INSTRUCTION MANUAL

MODELS (179) (279)

ELECTROLYTIC HYGROMETER

bulletin 526

Beckman® *process instruments*



MODELS (179) (279)

ELECTROLYTIC HYGROMETER

BECKMAN INSTRUMENTS, INC. *Process Instruments Division* Fullerton, California

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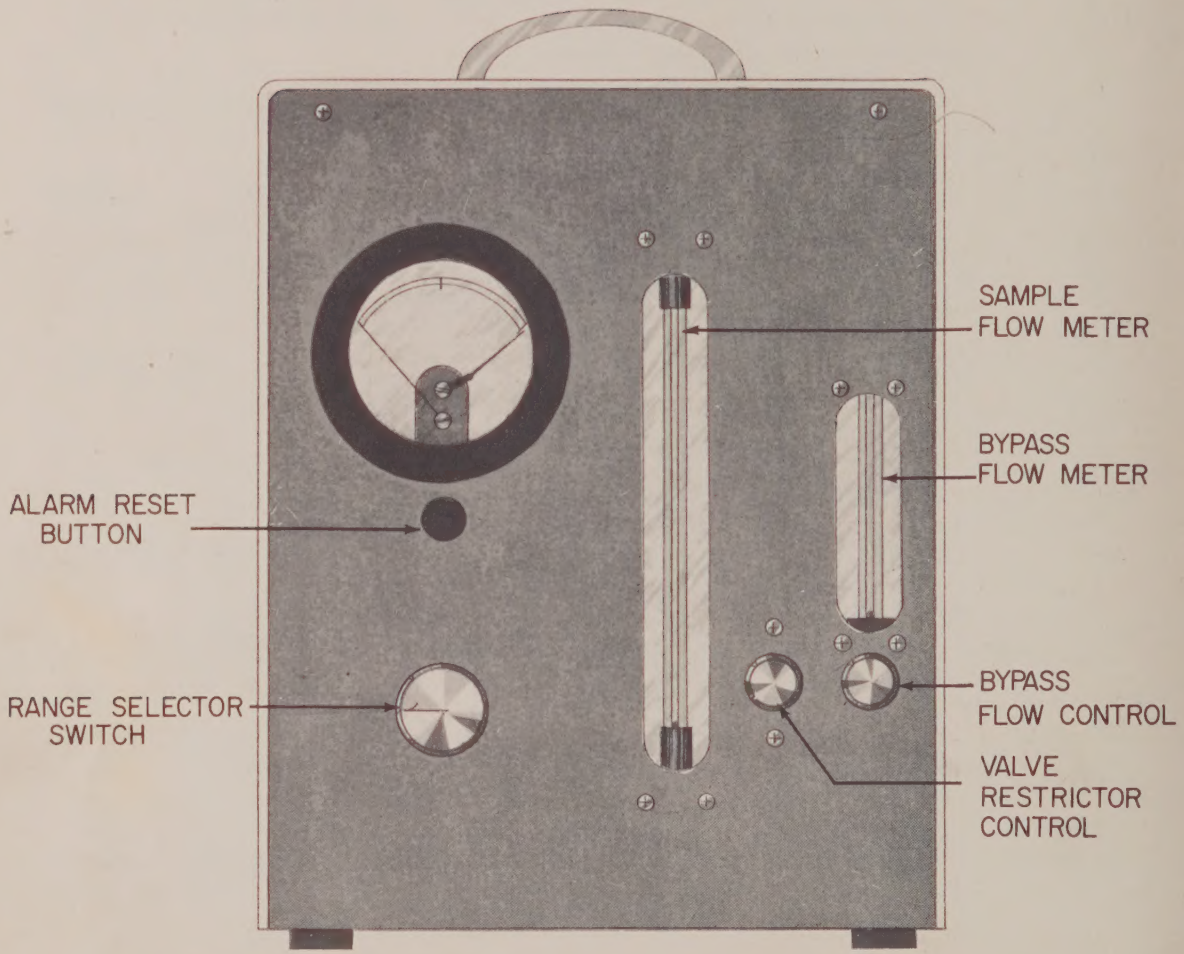

FIGURE 1. MODEL 179 ELECTROLYTIC HYGROMETER

SECTION 1. INTRODUCTION

1.1 DESCRIPTION

The BECKMAN Model 179 Electrolytic Hygrometer continuously measures water content in gaseous samples at temperatures up to 212°F (100°C). The 17901 Electrolytic Hygrometer incorporates a copper flow system. The 17902 Electrolytic Hygrometer incorporates a stainless steel flow system for water measurement of corrosive gaseous samples.

The Model 279 Electrolytic Hygrometer is housed in a panel mounted case in place of the instrument cover used on the Model 179. Otherwise, the Model 279 is identical to the Model 179. The 27901 Electrolytic Hygrometer incorporates a copper flow system. The 27902 Electrolytic Hygrometer incorporates a stainless steel flow system for water measurement of corrosive gaseous samples.

A system for maintaining constant flow of sample gas through the electrolytic cell ensures accurate water measurements by the instrument. The flow rate is adjustable over a wide range.

In operation, gaseous sample flows through the inlet to the electrolytic cell, which is the measuring element of the instrument (Figure 2). Here the sample passes over a thin film of phosphoric acid supported between two spirally-wound platinum electrodes within the cell. The phosphoric acid film absorbs the moisture in the sample.

An electric potential is applied between the electrodes, causing the absorbed water to disassociate into hydrogen and oxygen gases. The electric current produced by this disassociation is a measure of the concentration of water in the sample, and parts per million of water (by volume) can be read on the instrument meter.

1.2 SPECIFICATIONS

Ranges: 0 to 10, 0 to 30, 0 to 100, 0 to 300, and 0 to 1000 parts per million (by volume).

Accuracy: ± 5 percent

Sample Flow Rate: 100 cc/minute at inlet pressures of 10 to 100 psig.

Power Requirements: 100 to 125 volts, 50 to 60 cycles A.C., 20 watts.

Provisions for Alarm: Incorporates a double pole, double throw relay which can be set for any point in any of the instrument ranges. The relay output can be connected to a suitable alarm. The relay is rated at 5 amperes, 125 volts A.C., non-inductive load.

Output Signal: To 10 or 50 millivolt potentiometric recorder.

SECTION 2. PRINCIPLES OF OPERATION

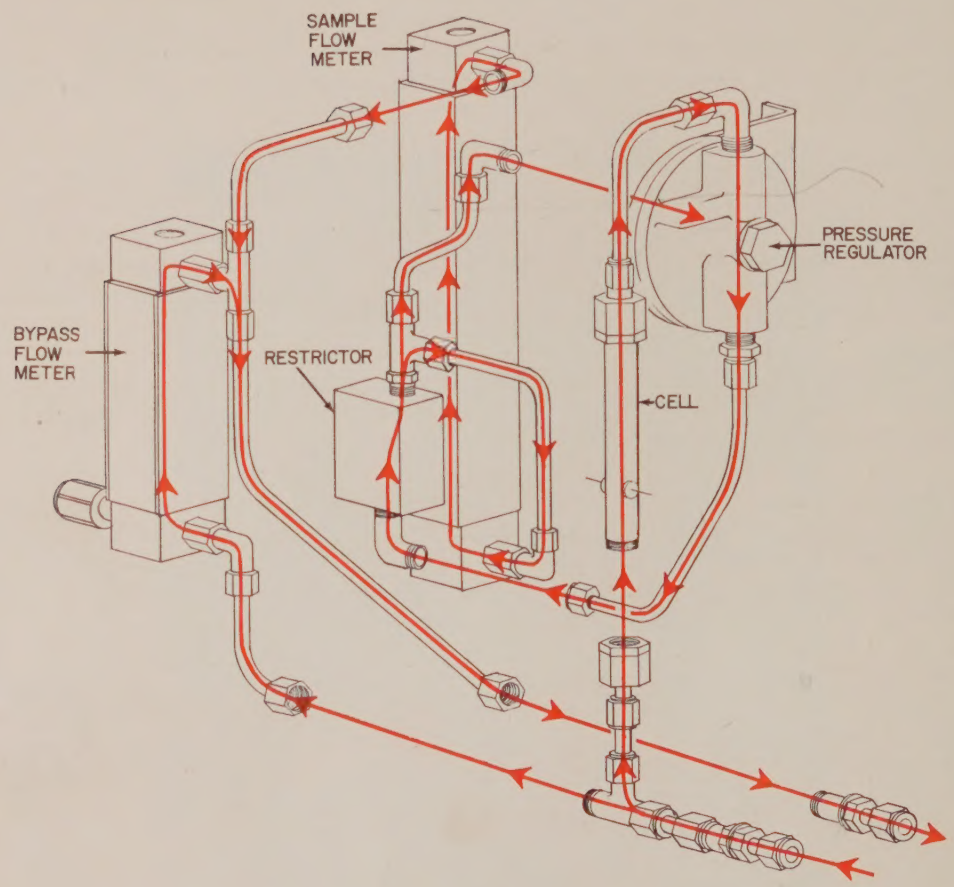

FIGURE 2. INSTRUMENT FLOW SCHEMATIC

FIGURE 2 IS A FLOW SCHEMATIC OF THE INSTRUMENT. GASEOUS SAMPLE FLOWS FROM THE SAMPLE SOURCE THROUGH THE GAS HANDLING SYSTEM TO THE INSTRUMENT INLET. THE FLOW RATE THROUGH THE INSTRUMENT ELECTROLYTIC CELL AND PRESSURE AT THE INSTRUMENT OUTLET ARE REGULATED FOR ACCURATE REPRODUCIBLE RESULTS. WHERE HIGH RATES OF SAMPLE FLOW ARE NECESSARY TO OBTAIN THE DESIRED RESPONSE TIME, A PORTION OF SAMPLE FLOW CAN BE BYPASSED THROUGH THE BYPASS VALVE AND FLOWMETER TO THE INSTRUMENT OUTLET. THIS SPEEDS INSTRUMENT RESPONSE WITHOUT OVERLOADING THE INSTRUMENT WITH SAMPLE.

GASEOUS SAMPLE FLOWS THROUGH THE INLET TO THE ELECTROLYTIC CELL. HERE MOISTURE IN THE SAMPLE IS ABSORBED BY A THIN FILM OF PHOSPHORIC ACID SUPPORTED BETWEEN THE PLATINUM ELECTRODES IN THE CELL. A D-C POTENTIAL IS APPLIED BETWEEN THE ELECTRODES, CAUSING THE ABSORBED WATER TO DISASSOCIATE INTO HYGROGEN GAS AND OXYGEN GAS. THE ELECTRIC CURRENT PRODUCED BY THIS DISASSOCIATION IS DIRECTLY PROPORTIONAL TO THE CONCENTRATION OF WATER IN THE SAMPLE. ACCORDING TO FARADAY'S LAW, ONE GRAM

EQUIVALENT WEIGHT OF MATTER (9 GRAMS OF WATER) IS CHEMICALLY ALTERED FOR EACH 96,500 COULOMBS (ONE FARADAY) PASSING THROUGH THE SAMPLE. THE WATER CONCENTRATION, IN PARTS PER MILLION, APPEARS ON THE INSTRUMENT METER.

THE GAS SAMPLE, WITH MOISTURE CONVERTED TO HYDROGEN AND OXYGEN GASES, FLOWS THROUGH ONE SIDE OF THE DIFFERENTIAL PRESSURE REGULATOR TO THE VALVE RESTRICTOR. THE TWO SIDES OF THE REGULATOR ARE SEPARATED BY A DIAPHRAGM. DOWNSTREAM OF THE RESTRICTOR, GAS FEEDS BACK TO THE SECOND SIDE OF THE REGULATOR. IMBALANCE IN THE PRESSURE ACROSS THE DIAPHRAGM OPENS OR CLOSES A VALVE IN THE REGULATOR UNTIL EQUILIBRIUM IS REACHED. AT THIS EQUILIBRIUM, WHICH IS REACHED AFTER INITIAL FLOW THROUGH THE SYSTEM, A CONSTANT FLOW IS MAINTAINED THROUGH THE ELECTROLYTIC CELL. THIS CONSTANT FLOW RATE CAN BE CHANGED BY OPENING OR RESTRICTING THE VALVE RESTRICTOR.

THE GASEOUS SAMPLE FLOWS THROUGH THE SAMPLE FLOWMETER, THEN TO THE INSTRUMENT OUTLET. WITH A SAMPLE FLOW OF 100 CC/MINUTE AT 70°F AND AN OUTLET PRESSURE OF 14.7 PSIA, THE INSTRUMENT METER READS DIRECTLY IN PARTS PER MILLION OF WATER VAPOR. AT DIFFERENT TEMPERATURES AND OUTLET PRESSURES, THE SAMPLE FLOW RATE SHOULD BE ADJUSTED AS DESCRIBED IN SECTION 4; THIS RESULTS IN INSTRUMENT METER READINGS DIRECTLY IN PARTS PER MILLION OF WATER VAPOR.

SECTION 3. INSTALLATION

NOTE: BECKMAN ELECTROLYTIC HYGROMETERS ARE SHIPPED WITH THE INLET AND OUTLET COVERED TO PREVENT UNNECESSARY ABSORPTION OF MOISTURE BY THE INSTRUMENT ELECTROLYTIC CELL DURING SHIPMENT. NEVER LEAVE THE INLET AND OUTLET OPEN TO THE AIR FOR MORE THAN SHORT PERIODS OF TIME. THIS HELPS PREVENT LONG DRYING OUT TIME BEFORE THE INSTRUMENT IS USED.

IN MANY CASES IT WILL NOT BE POSSIBLE TO GET ACCURATE MOISTURE MEASUREMENTS IMMEDIATELY UPON RECEIPT OF THE INSTRUMENT. A DRYING OUT PERIOD OF SEVERAL HOURS MAY BE REQUIRED. IN GENERAL, WHEN USING THE 10 AND 20 PARTS PER MILLION RANGE, TWO TO THREE HOURS OF DRYING MAY BE REQUIRED. USE THE PROCEDURE DESCRIBED UNDER OPERATION.

3.1 SAMPLE HANDLING SYSTEM SUGGESTIONS

3.1.1 KEEP ALL LINES TO THE INSTRUMENT AS SHORT AS POSSIBLE.

3.1.2 MINIMIZE THE SURFACE AREA OF TUBING AND FITTINGS WHICH ARE EXPOSED TO THE SAMPLE. THIS MINIMIZES THE TIME FOR MOISTURE EQUILIBRIUM BETWEEN THE SAMPLE AND THE MATERIALS WHICH THE SAMPLE CONTACTS.

3.1.3 COMPONENTS WHICH COMPOSE THE SAMPLE HANDLING SYSTEM SHOULD HAVE LOW MOISTURE ABSORPTION. USE OF STAINLESS STEEL IS PREFERABLE, ALTHOUGH COPPER AND BRASS ARE ACCEPTABLE. IN GENERAL, NO PLASTIC OR ELASTOMERIC MATERIALS SHOULD BE USED BECAUSE OF THEIR HIGH MOISTURE PERMEABILITY.

3.2 MOUNTING PROCEDURE (MODEL 279 ONLY)

3.2.1 REMOVE THE MOUNTING BRACKETS ON BOTH SIDES OF THE INSTRUMENT CASE.

3.2.2 INSERT THE INSTRUMENT INTO A PANEL CUT-OUT. RECOMMENDED DIMENSIONS ARE 9-9/16 INCHES BY 11-15/16 INCHES. SEE FIGURE 3.

3.2.3 REPLACE THE MOUNTING BRACKETS ON THE SIDES OF THE INSTRUMENT. TIGHTEN THE BOLTS FITTING THROUGH THE BRACKETS AGAINST THE MOUNTING SURFACE; MAXIMUM MOUNTING SURFACE THICKNESS IS 1-1/4 INCHES.

3.2.4 LOCK THE MOUNTING BOLTS IN PLACE BY TIGHTENING THE NUTS ON THE BOLTS AGAINST THE FRONTS OF THE MOUNTING BRACKETS.

3.3 INSTALLATION PROCEDURE

3.3.1 INSPECT THE SAMPLE LINE TO BE SURE IT IS FREE OF DUST OR OTHER CONTAMINANTS WHICH MIGHT PLUG THE ELECTROLYTIC CELL.

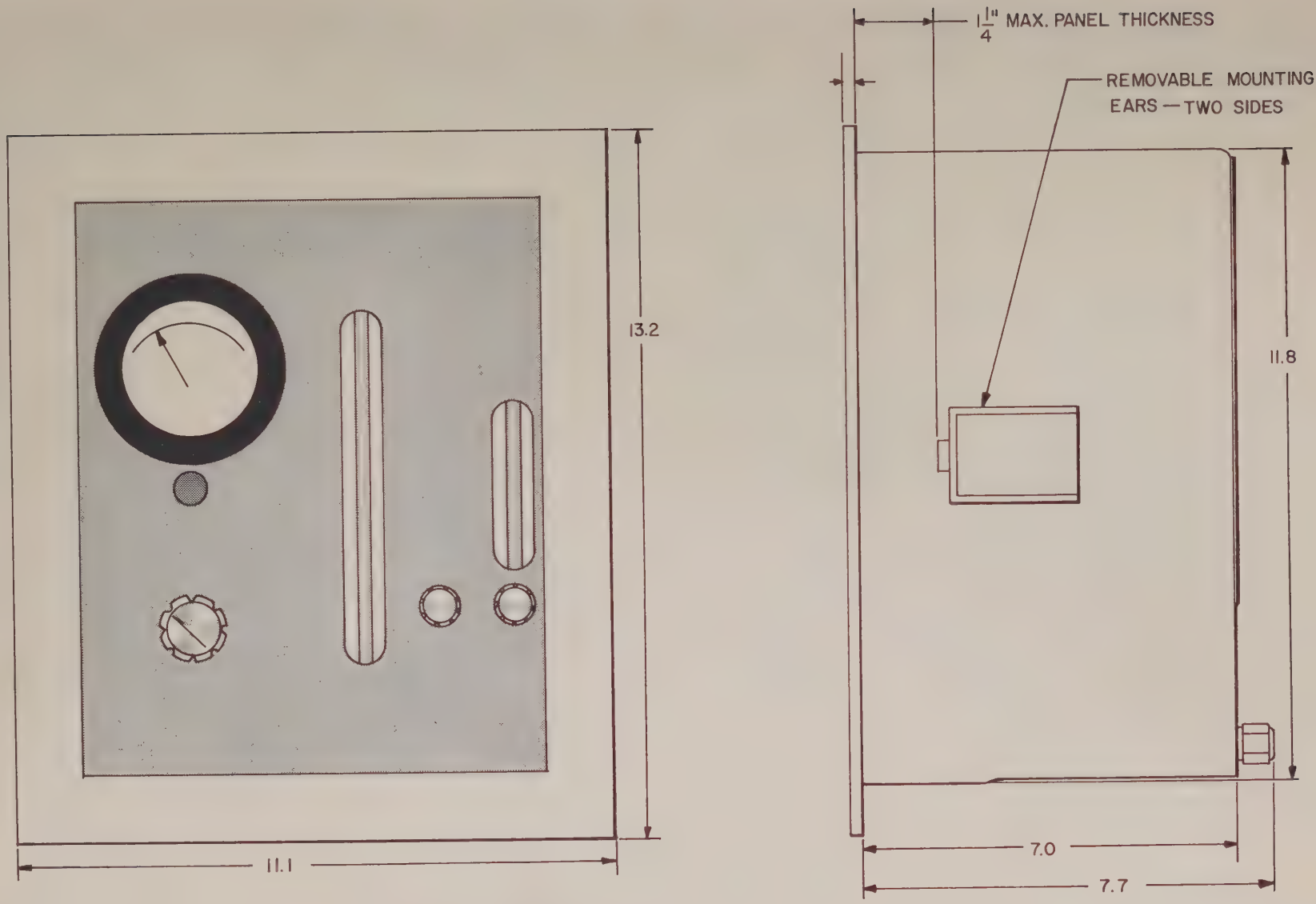

FIGURE 3. MOUNTING DIMENSIONS - MODEL 279 ELECTROLYTIC HYGROMETER

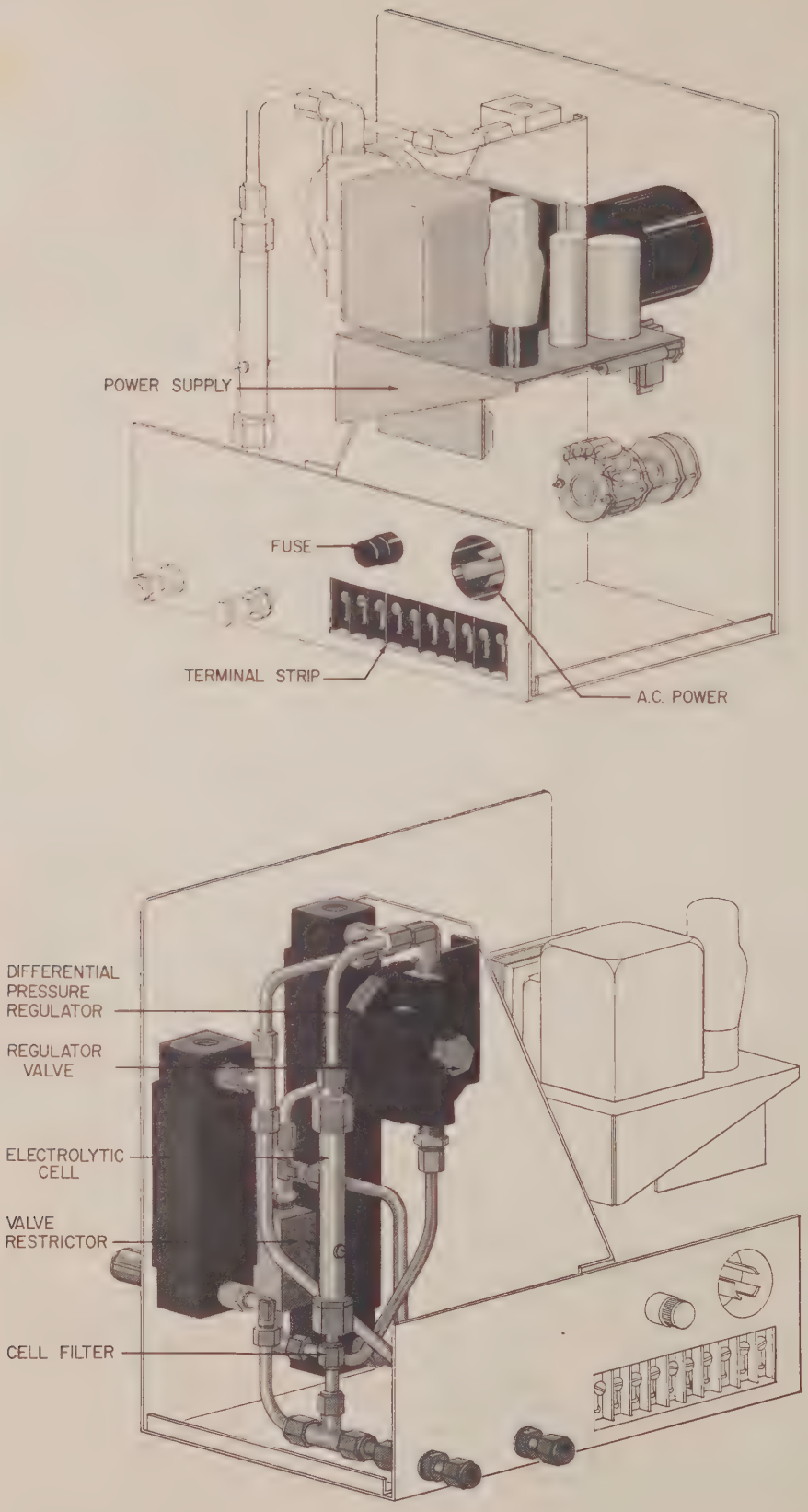

FIGURE 4. INSTRUMENT REAR PANEL

Flush the sample line with dry gas for a short period of time.

See Figure 4. Connect the dry, clean line from the sample handling system to the instrument INLET, using 1/4 inch o.d. tubing and appropriate fittings.

NOTE: Use of a long sample line increases the system response time. To decrease response time, use small diameter lines and bypass part of the flow. Bypass flow rate is indicated on the small flowmeter (Figure 1).

3.3.2 If desired, connect a 1/4 inch o.d. exhaust line to OUTLET.

NOTE: The OUTLET should be at atmospheric pressure for best results. If the OUTLET is at constant pressure other than atmospheric, correct the flow rate through the instrument as instructed in Section 4.2.4.

3.3.3 See Figure 5. If a recorder is used, connect it to the terminal strip on the rear panel. Either a 10-millivolt or a 50-millivolt potentiometric recorder can be used.

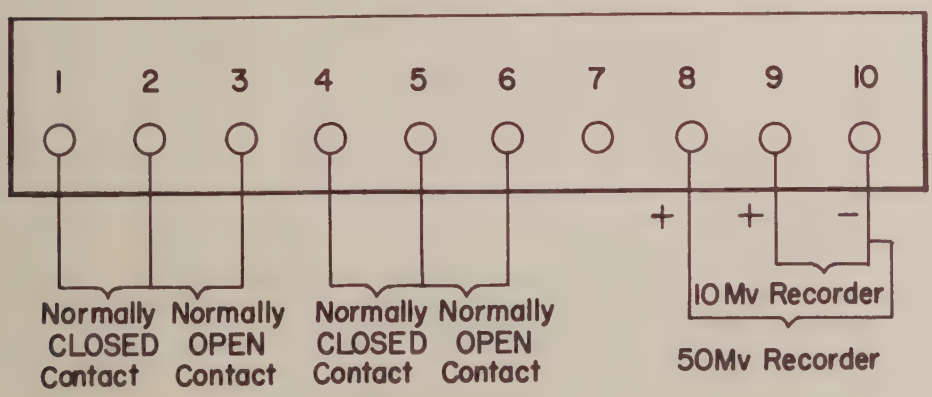

FIGURE 5. RECORDER AND ALARM SWITCH CONNECTIONS

3.3.4 If an external alarm system is used, connect it to the terminal strip on the rear panel as indicated on Figures 5 and 6. Relay contacts are rated at 5 amperes, 125 volts, A.C., non-inductive load.

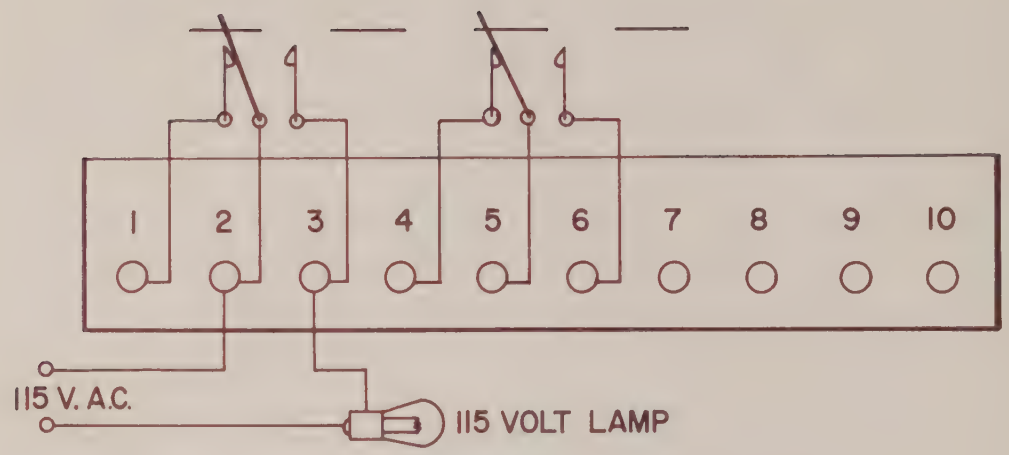

FIGURE 6. TYPICAL ALARM SYSTEM CONNECTIONS

3.3.5 SET THE ALARM TRIP TO THE DESIRED POINT BY TURNING THE ADJUSTMENT SCREW ON THE METER FACE (FIGURE 7) UNTIL THE ALARM TRIP NEEDLE IS ALIGNED WITH THE DESIRED VALUE.

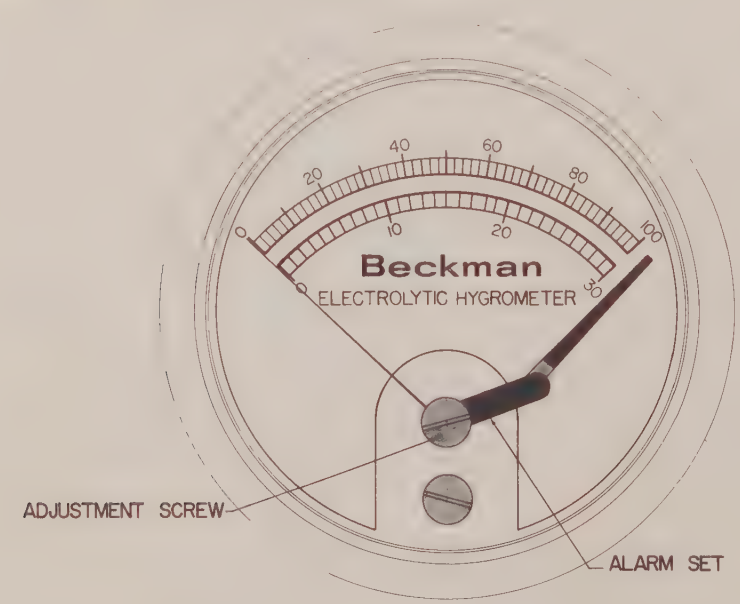

FIGURE 7. ALARM TRIP ADJUSTMENT

3.3.6 Connect the twist-lock power plug to the receptable on the rear of the instrument. Plug the power cord into a source of 115 volts, 50 or 60 cycles a.c. Connect the green wire (with spade lug) to earth ground.

SECTION 4. OPERATION

4.1 OPERATING CONTROLS

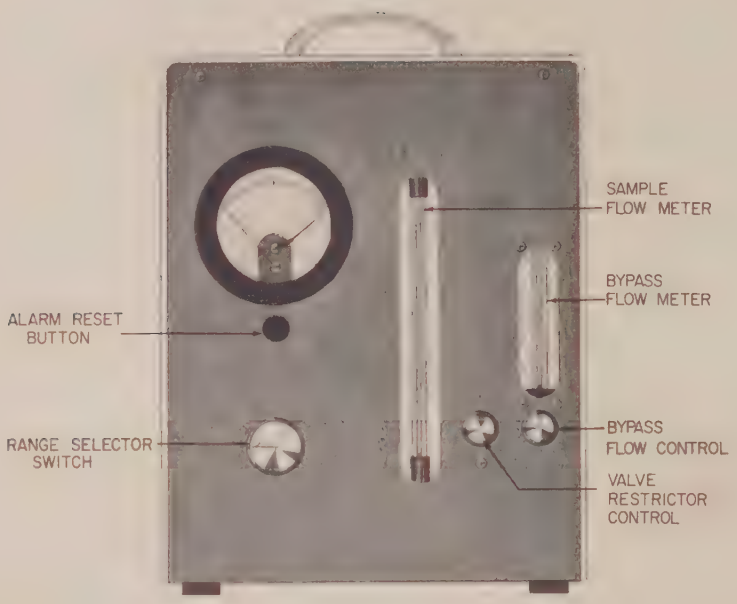

FIGURE 8. INSTRUMENT CONTROLS

4.1.1 Range Selector Switch

This switch has seven positions, OFF, STANDBY, 1000, 300, 100, 30, and 10. The numbered positions correspond to the full-scale parts per million of water indicated by the instrument meter at that switch position.

NOTE: In earlier instruments the position may be marked ∞ instead of STANDBY.

Switching from OFF to the STANDBY position turns the instrument ON. The instrument is warmed up and the electrolytic cell dried with the switch in the STANDBY position. Drying the instrument with the switch in any other position may trip the alarm relay.

4.1.2 Valve Restrictor

This needle valve regulates the flow rate of sample through the electrolytic cell.

CAUTION: Never tighten the Valve Restrictor if sample is not flowing through the instrument. Too much tightening may deform the needle in the needle valve. With sample flow ON, only tighten the restrictor until the sample flow is reduced to the desired flowmeter setting.

NOTE: In earlier instruments a flow restrictor may be used instead of the needle valve restrictor. To adjust the flow rate on these instruments, Remove the back cover of the hygrometer so the interior of the instrument is visible. Move the adjustable slide of the restrictor; the arrow indicates direction for increased flow rate. The flow restrictor is located just below the Regulator Valve.

4.1.3 Bypass Valve

This needle valve controls the rate of bypass flow (indicated on the bypass flowmeter) from 0 to 2 cubic feet per hour (approximately 940 cc/minute). Instrument response can be increased by increasing the rate of sample flow to the instrument and bypassing the flow in excess of 100 cc/minute through the bypass valve.

4.1.4 Alarm Reset Button

This mechanical reset breaks the contacts of the alarm relay. It is used to reset the instrument after the alarm has been tripped.

4.2 OPERATION

4.2.1 Allow sample to flow through the instrument to dry it out. Use a gas sample with moisture content less than 1000 parts per million. Adjust the sample inlet pressure to 10-100 psig. Adjust the flow rate through the instrument as described in Section 4.2.3 following.

Turn the range selector switch to the STANDBY range. This turns the instrument on. Allow the instrument to dry out for approximately 30 minutes. After 30 minutes turn the range selector switch to the desired range. The meter needle will be on-scale if the instrument is sufficiently dried.

If the meter needle trips the alarm, return the range selector switch to the STANDBY position and press the alarm reset button. Pass drying gas through the instrument for additional time, checking as described above.

4.2.2 When the instrument is sufficiently dried, turn the range selector switch to the desired range.

4.2.3 Adjust the rate of sample flow through the electrolytic cell. At 70°F and instrument outlet pressure of 14.7 psia, meter readings are in parts per million of water when the sample flow rate is 100 cc/minute.

The sample flowmeter is calibrated for air. When samples other than air are analyzed, the sample flowmeter reads values other than 100 for flows of 100 cc/minute. To calculate the flowmeter reading for a flow rate of 100 cc/minute, use the following equation:

$$\text{Flowmeter reading for 100 cc/minute} = 100 \sqrt{\frac{\text{density of sample gas}}{\text{density of air}}}$$

To adjust the flow rate, rotate the Valve Restrictor until the proper flowmeter reading is obtained.

NOTE: The flowmeter normally supplied has readings of 0 to 195 cc/minute. Two other flowmeters are available on special order. The flowmeter with reading range of 0 to 95 cc/minute is for gases less dense than air. The flowmeter with reading range of 0 to 450 cc/minute is for gases more dense than air.

out

ARGON 105 TABLE I

TYPICAL FLOWMETER SETTINGS*
(70°F, 14.7 psia outlet pressure)

GAS	FLOWMETER SETTING* cc/minute
Acetylene	95.3
Air	100
~~Ammonia~~	~~77.2~~
Carbon Dioxide	124
Chlorine	157
Ethane	102
Freon 12	205
Freon 22	173
Helium	37.2
Hydrogen	26.4
Hydrogen Chloride	113
Methane	74.5
Nitrogen	98.6
Sulfur Dioxide	149
Oxygen	115

*These settings result in meter readings in parts per million by volume of water.

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4.2.4 If the gas sample temperature differs from 70°F, or the outlet pressure differs from 14.7 psia, the flowmeter setting must be adjusted so that the sample flow rate is equivalent to 100 cc/minute at 70°F and 14.7 psia. To calculate the correct flowmeter setting, use the following equation:

$$\text{Corrected Flowmeter Setting} = \text{Flowmeter reading from Step 4.2.3} \sqrt{\frac{(\text{sample } ^\circ\text{F} + 460)(14.7 \text{ psia})}{(530)(\text{sample psia})}}$$

To obtain proper flowmeter setting, adjust the flow rate as described in Step 4.2.3.

4.2.5 With the flow rate adjusted and the sample flowing through the instrument, the instrument meter reads directly in parts per million, by volume, of water.

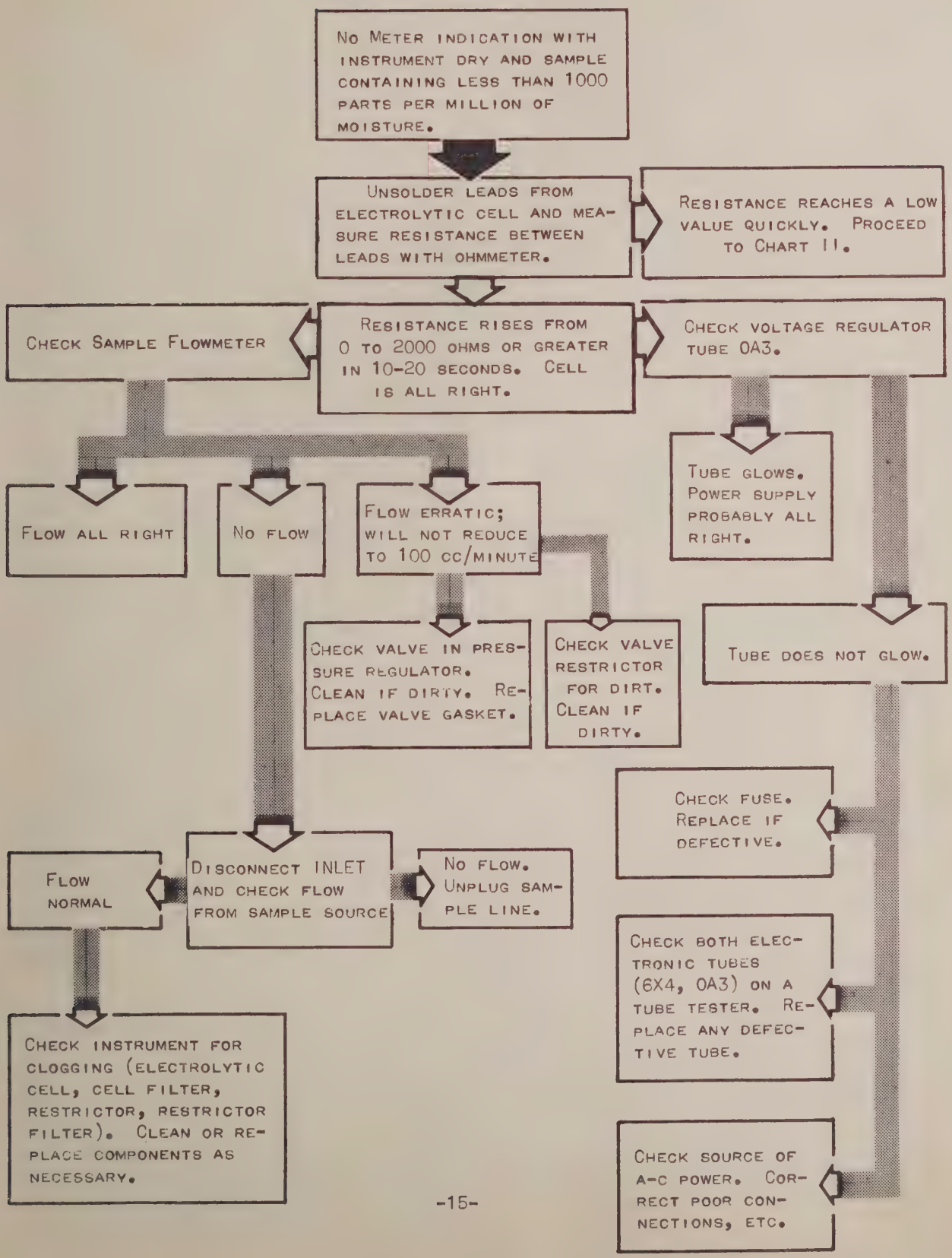
4.2.6 If faster system response is desired, increase sample flow rate from the sample reservoir and bypass part of the sample flow by opening the needle valve beneath the bypass flowmeter. Adjust the needle valve to give the desired bypass flow rate.

4.2.7 When the meter reading exceeds the alarm set point, the meter movement locks. Reset the alarm meter by pushing the Alarm Reset Button on the instrument front panel.

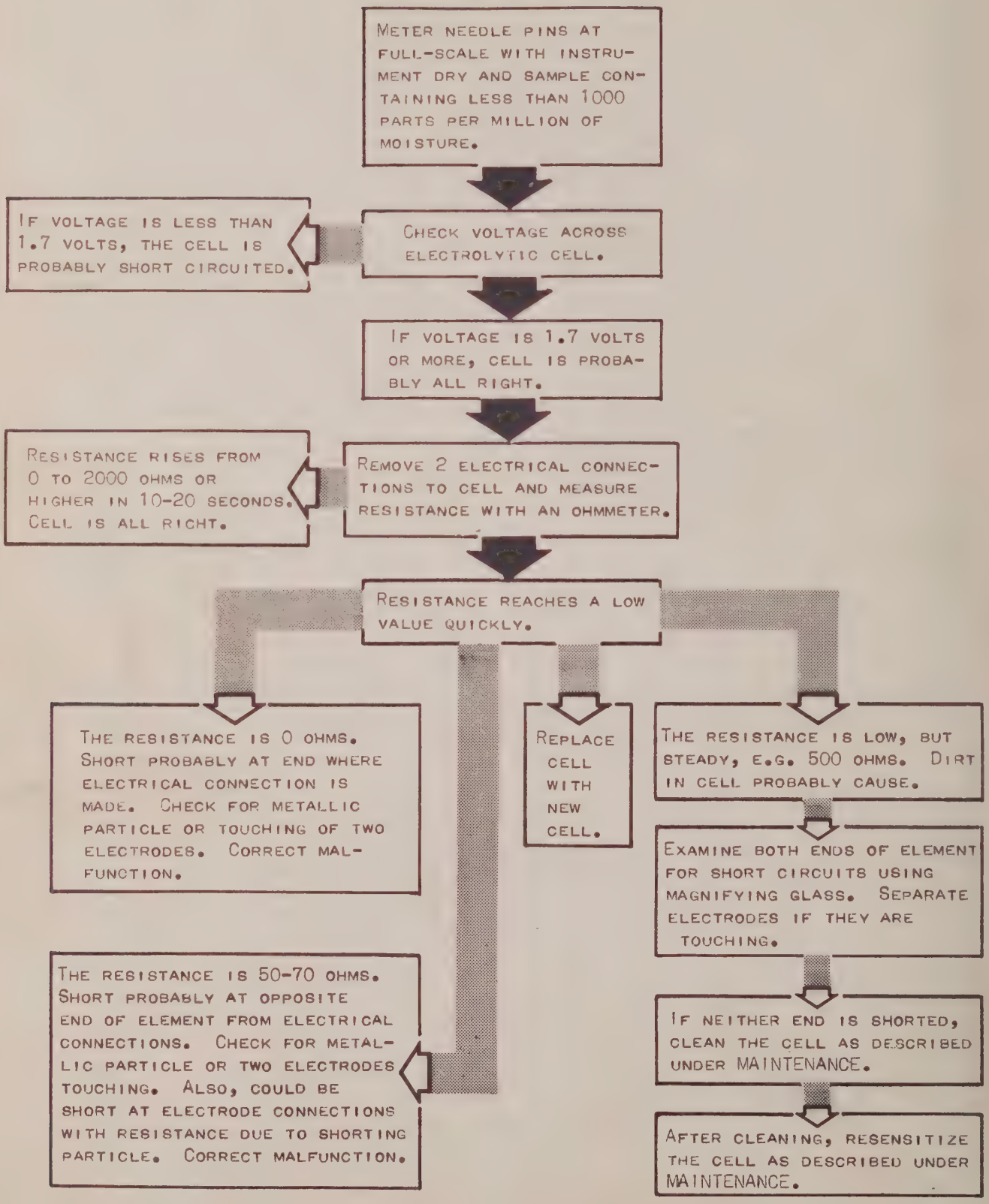
SECTION 5. TROUBLE-SHOOTING

INSTRUMENT MALFUNCTIONING IS EVIDENT BY LACK OF INSTRUMENT METER INDICATION WHICH MAY BE DUE TO MALFUNCTIONING OF THE FLOW SYSTEM OR TO MALFUNCTIONING OF THE POWER SUPPLY. MALFUNCTIONING IS ALSO EVIDENT IF THE METER NEEDLE PINS AT FULL-SCALE RANGE IF GAS WITH MOISTURE LESS THAN 1000 PARTS PER MILLION IS FLOWING THROUGH THE INSTRUMENT. CHARTS 1 AND 2 ARE SIMPLIFIED FLOW CHARTS FOR LOCATING ANY SUCH MALFUNCTION. SECTION 6. MAINTENANCE, INCLUDES SOME TESTS WHICH ARE OF ASSISTANCE IN CHECKING FOR POSSIBLE MALFUNCTIONS BEFORE THEY OCCUR. SECTION 6 ALSO INCLUDES INSTRUCTIONS FOR COMPONENT REPLACEMENTS IF TROUBLE-SHOOTING HAS INDICATED THAT SUCH REPLACEMENTS ARE NECESSARY.

TROUBLE-SHOOTING
ELECTROLYTIC HYGROMETER
CHART I


No Meter indication with instrument dry and sample containing less than 1000 parts per million of moisture.
Unsolder leads from electrolytic cell and measure resistance between leads with ohmmeter.
Resistance reaches a low value quickly. Proceed to Chart II.
Resistance rises from 0 to 2000 ohms or greater in 10-20 seconds. Cell is all right.
Check Sample Flowmeter
Check voltage regulator tube 0A3.
Flow all right
No flow
Flow erratic; will not reduce to 100 cc/minute
Tube glows. Power supply probably all right.
Tube does not glow.
Check valve in pressure regulator. Clean if dirty. Replace valve gasket.
Check valve restrictor for dirt. Clean if dirty.
Check fuse. Replace if defective.
Disconnect inlet and check flow from sample source
Flow normal
No flow. Unplug sample line.
Check both electronic tubes (6X4, 0A3) on a tube tester. Replace any defective tube.
Check instrument for clogging (electrolytic cell, cell filter, restrictor, restrictor filter). Clean or replace components as necessary.
Check source of a-c power. Correct poor connections, etc.

TROUBLE-SHOOTING
ELECTROLYTIC HYGROMETER
CHART II


METER NEEDLE PINS AT FULL-SCALE WITH INSTRUMENT DRY AND SAMPLE CONTAINING LESS THAN 1000 PARTS PER MILLION OF MOISTURE.
CHECK VOLTAGE ACROSS ELECTROLYTIC CELL.
IF VOLTAGE IS LESS THAN 1.7 VOLTS, THE CELL IS PROBABLY SHORT CIRCUITED.
IF VOLTAGE IS 1.7 VOLTS OR MORE, CELL IS PROBABLY ALL RIGHT.
REMOVE 2 ELECTRICAL CONNECTIONS TO CELL AND MEASURE RESISTANCE WITH AN OHMMETER.
RESISTANCE RISES FROM 0 TO 2000 OHMS OR HIGHER IN 10-20 SECONDS. CELL IS ALL RIGHT.
RESISTANCE REACHES A LOW VALUE QUICKLY.
THE RESISTANCE IS 0 OHMS. SHORT PROBABLY AT END WHERE ELECTRICAL CONNECTION IS MADE. CHECK FOR METALLIC PARTICLE OR TOUCHING OF TWO ELECTRODES. CORRECT MALFUNCTION.
REPLACE CELL WITH NEW CELL.
THE RESISTANCE IS LOW, BUT STEADY, E.G. 500 OHMS. DIRT IN CELL PROBABLY CAUSE.
EXAMINE BOTH ENDS OF ELEMENT FOR SHORT CIRCUITS USING MAGNIFYING GLASS. SEPARATE ELECTRODES IF THEY ARE TOUCHING.
IF NEITHER END IS SHORTED, CLEAN THE CELL AS DESCRIBED UNDER MAINTENANCE.
AFTER CLEANING, RESENSITIZE THE CELL AS DESCRIBED UNDER MAINTENANCE.
THE RESISTANCE IS 50-70 OHMS. SHORT PROBABLY AT OPPOSITE END OF ELEMENT FROM ELECTRICAL CONNECTIONS. CHECK FOR METALLIC PARTICLE OR TWO ELECTRODES TOUCHING. ALSO, COULD BE SHORT AT ELECTRODE CONNECTIONS WITH RESISTANCE DUE TO SHORTING PARTICLE. CORRECT MALFUNCTION.

SECTION 6. MAINTENANCE

6.1 OPERATIONAL TESTS

6.1.1 Leak Test

6.1.1.1 Plug the instrument outlet, open the bypass valve, and connect a pressure gauge (range: 0-50 psig) to the instrument inlet.

6.1.1.2 Connect the instrument inlet to a source of dry, dust-free air or nitrogen, and pressurize the hygrometer to 30 psig.

6.1.1.3 Shut off the source of gas. Pressure in the instrument should not drop more than 1 psig in 5 minutes.

6.1.1.4 If the pressure drop in 5 minutes is more than 1 psig, check and tighten all fittings in the instrument.

6.1.2 Flow Regulation Check

6.1.2.1 First check the instrument for leaks.

6.1.2.2 Connect dry, dust-free air or nitrogen to the inlet of the leak-free instrument. Gas pressure should be variable from 10 to 100 psi.

6.1.2.3 Adjust the inlet gas pressure to 10 psi. Vary the valve restrictor. The flow range should be at least from 20 to 175 cc/minute.

6.1.2.4 Adjust the inlet gas pressure to 100 psig. Vary the valve restrictor. The flow range should be at least 20 to 175 cc/minute.

6.1.2.5 Adjust the inlet gas pressure to 10 psi. Set the valve restrictor so flow is 100 cc/minute. Vary the inlet pressure from 10 to 100 psi. The flow should not vary more than ± 10 cc/minute.

6.1.2.6 If flow is not correct, check the instrument as per Trouble-Shooting Chart 1.

6.2 REPLACEMENTS

6.2.1 Electrolytic Cell

6.2.1.1 Pull the instrument plug from the source of power. Unsolder the leads connected to the cell.

6.2.1.2 Unscrew the connectors (Figure 9) which attach the electrolytic cell to the rest of the instrument flow system.

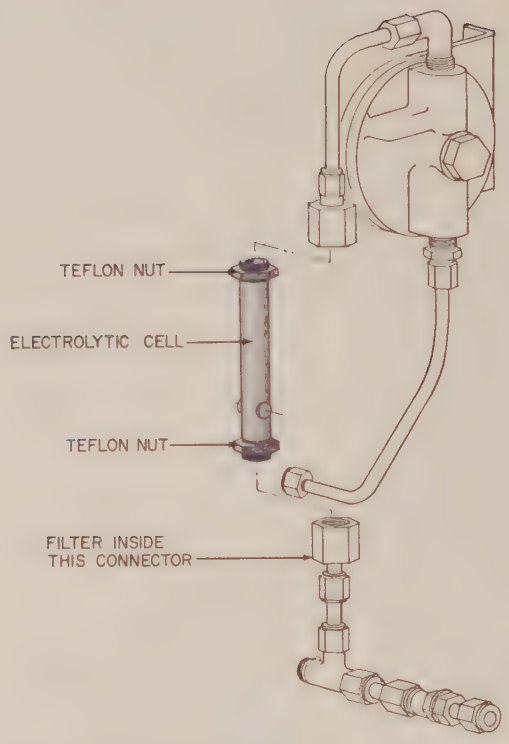


FIGURE 9. ELECTROLYTIC CELL REPLACEMENT

6.2.1.3 Remove the filter connected to the inlet side of the cell, and remove the Teflon nuts from the ends of the cell.

6.2.1.4 Clean the analyzer cell filter and replace it within the inlet connector.

6.2.1.5 Remove the protective rubber caps from the ends of the new cell. Screw the cell into the flow system, first replacing the Teflon nuts on the ends of the cell. Use the connectors previously removed, tightening them firmly.

6.2.1.6 Solder the instrument leads to the lugs on the new electrolytic cell. Solder either lead to either lug.

If time permits, check the instrument for leaks as described in Section 6.1.

6.2.2 Flow Regulator Valve Gasket

6.2.2.1 Unscrew the hexagonal plug on the back of the flow regulator (Figure 10).

6.2.2.2 Remove the small spring, valve stem, and valve gasket from the regulator.

6.2.2.3 Place a new valve gasket on the end of the valve stem. Replace the valve stem (plus gasket), and small spring inside the flow regulator. Replace the hexagonal plug on the flow regulator.

NOTE: If the valve stem is dirty, clean it before replacing it in the flow regulator.

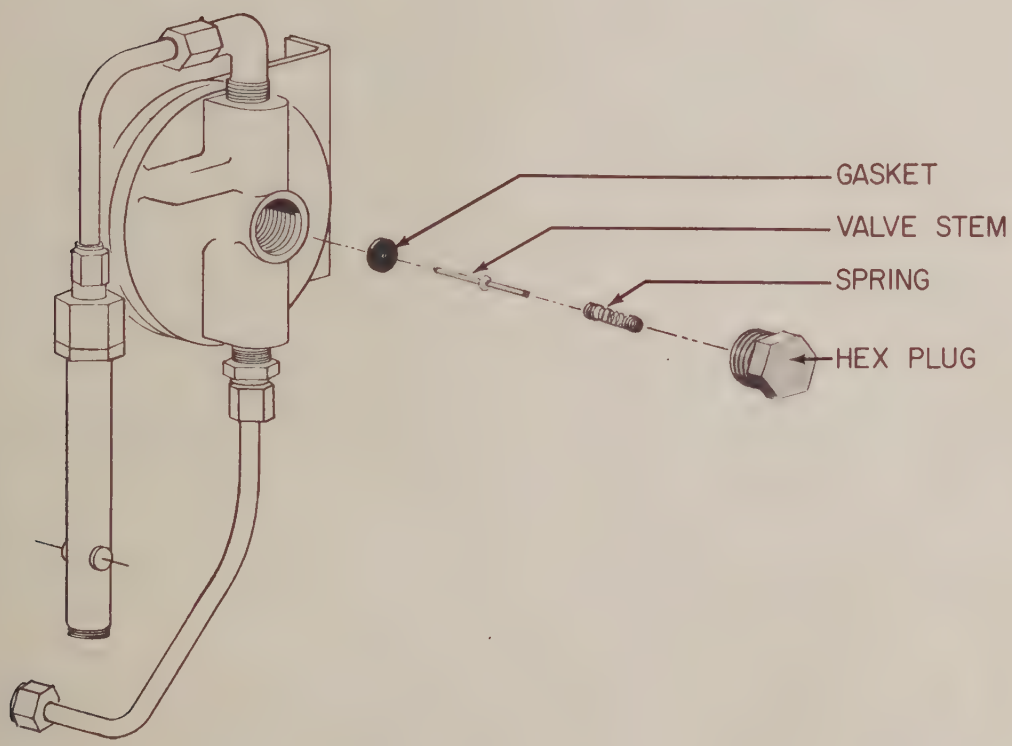


FIGURE 10. FLOW REGULATOR VALVE GASKET REPLACEMENT

6.3 MAINTENANCE

6.3.1 Cleaning Electrolytic Cell

6.3.1.1 Unsolder the electrical leads from the electrolytic cell. Unscrew the connectors which attach the electrolytic cell to the rest of the instrument flow system, and remove the cell from the instrument.

6.3.1.2 Mount the cell in a manner which permits application of suction on one end of the cell. One suggestion is to mount the cell in a rubber stopper which can be inserted in a suction flask. Mount the cell so that when vacuum is applied, flow through the cell will be the reverse of normal flow. Place a short piece of rubber tubing over the exposed end of the cell to prevent damage to the exposed electrodes.

6.3.1.3 Apply a vacuum to the suction flask with mounted cell, and fill the rubber tubing on the exposed end of the cell with distilled water. Draw water through the cell as fast as the vacuum will permit. Use a minimum of 20 cc of water; effective cleaning may require two to three hours.

6.3.1.4 Pass clean, dry air (or nitrogen) through the cell to dry it. Check the resistance across the cell. If the resistance is less than one megohm, repeat the cleaning process with a different solvent.

If distilled water proves ineffective, use carbon tetrachloride. If this does not work, use, in order, acetone, ten percent nitric acid, or aqua regia. After each cleaning rinse the cell with distilled water. Dry the cell and measure its resistance as described above.

> CAUTION: If aqua regia is used, extreme caution must be exercised, since this reagent will dissolve the platinum electrodes if used in more than small amounts.

6.3.1.5 After the cell has been cleaned, indicated by a cell resistance of one megohm or greater, sensitize the cleaned cell as per Section 6.3.2.

6.3.2 Resensitizing Cleaned Cells

6.3.2.1 Mount the cell in a manner which permits application of vacuum on one end. See Section 6.3.1.2.

6.3.2.2 Fill the rubber tubing on the exposed end of the cell with approximately ten cubic centimeters of ten percent phosphoric acid.

After all the acid has been pulled through the cell, apply vacuum for about five more minutes to insure that any excess acid has been removed.

6.3.2.3 Remove the cell from the vacuum system, and connect the cell to a source of DC voltage. The source should not exceed 100 volts, with a current through the cell not greater than 10 milli-amperes. However, the potential should be greater than two volts to remove excess moisture adhering to the acid film. Figure 11 is a typical drying circuit. Place the cell in such a circuit for about 30 minutes.

NOTE: If desired, the cell may be connected electrically to the hygrometer rather than to an external source of voltage. In this case, reconnect the cell to leads in the hygrometer, and place the cell in such a position that no moisture will leak onto the hygrometer. DO NOT connect the cell into the hygrometer flow system at this time.

6.3.2.4 After 30 minutes, carefully wipe both ends of the cell and the cell body to remove any residual acid or water. Replace the cell in the instrument flow system, tightening connectors firmly and soldering electrical leads to the cell terminals.

It is recommended that the instrument be placed in STANDBY position and dry air or dry nitrogen passed through the cell until the instrument meter reads on scale.

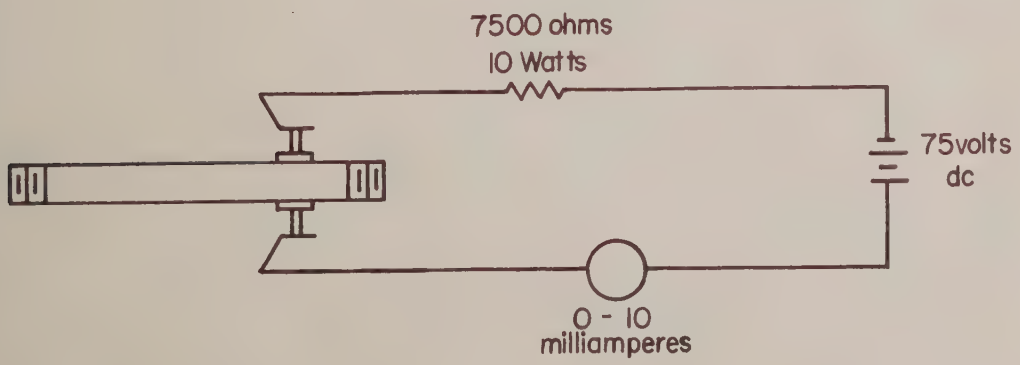


FIGURE 11. CELL DRYING CIRCUIT

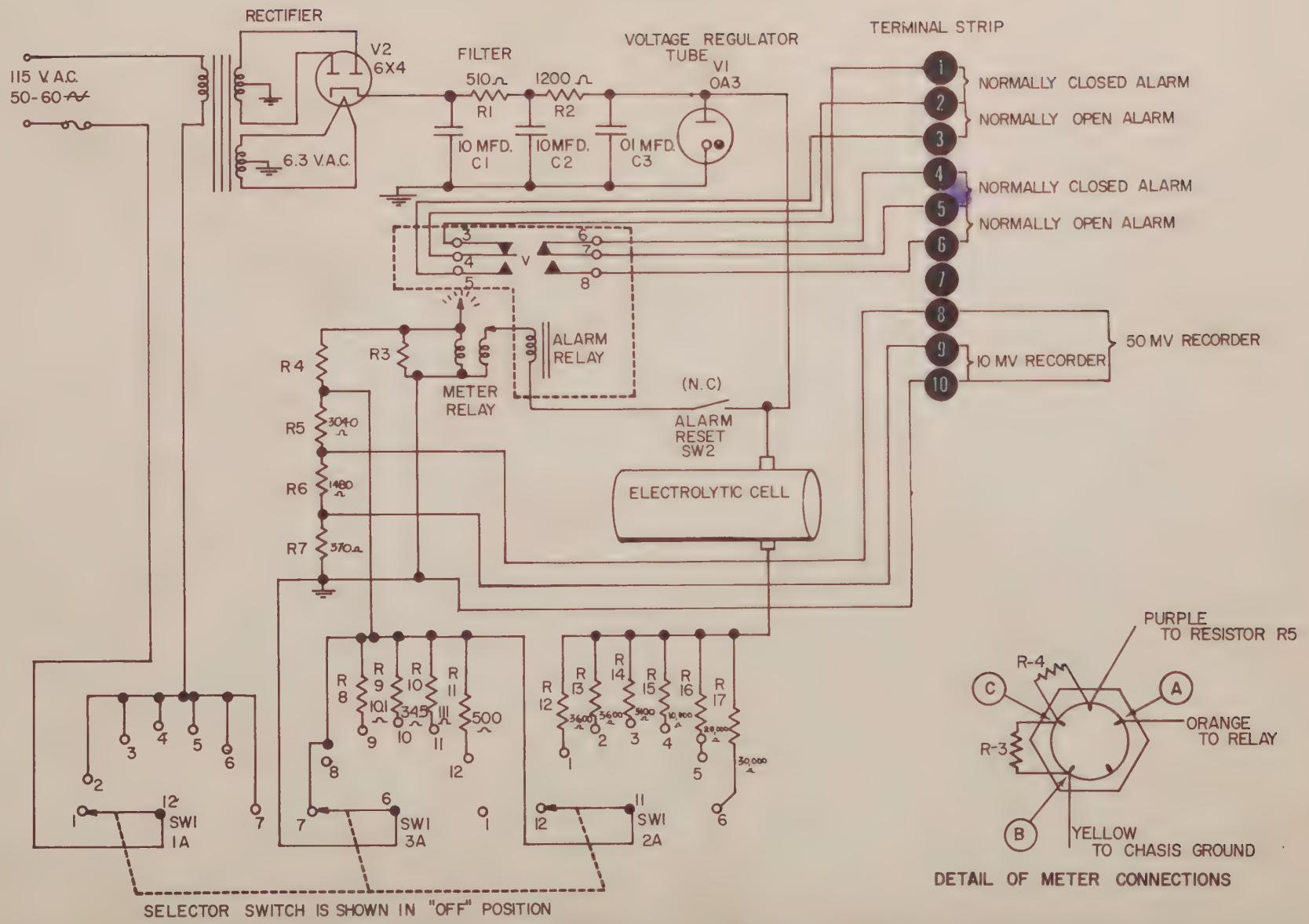
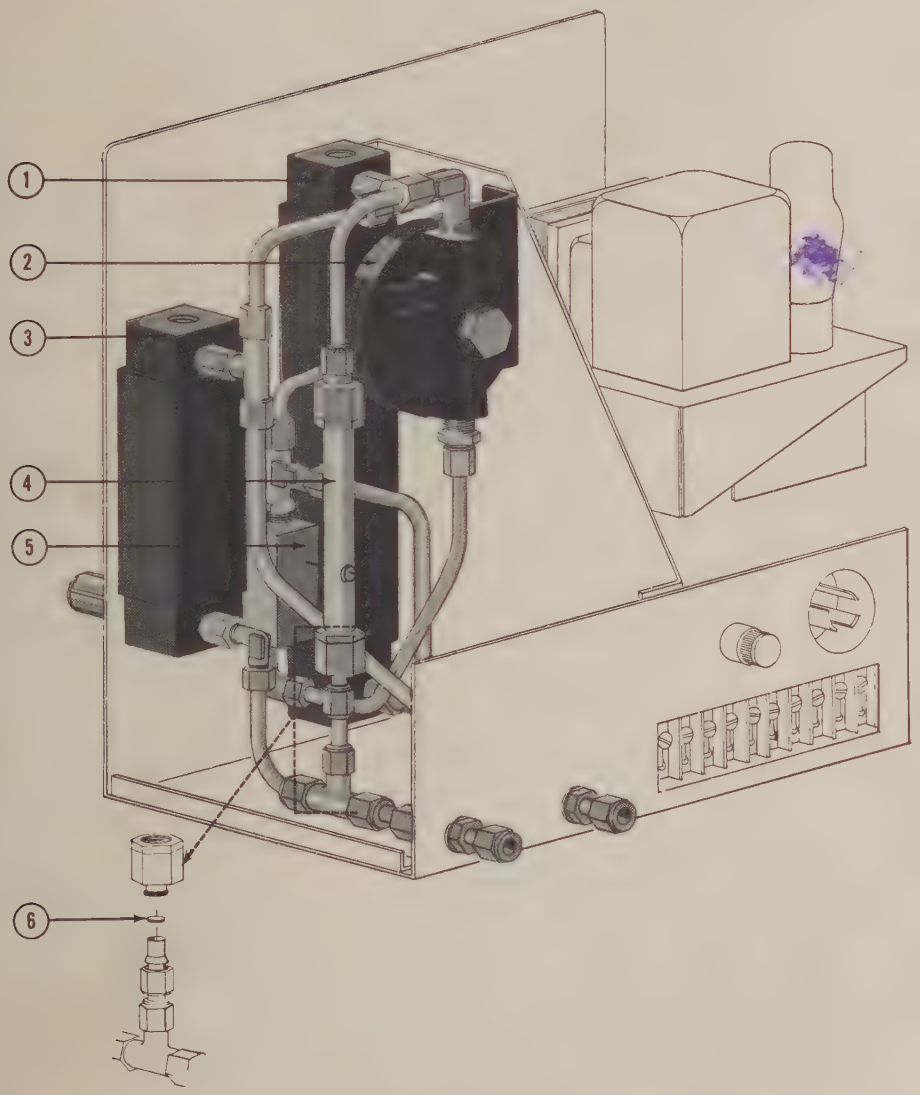


FIGURE 12. ELECTRICAL SCHEMATIC

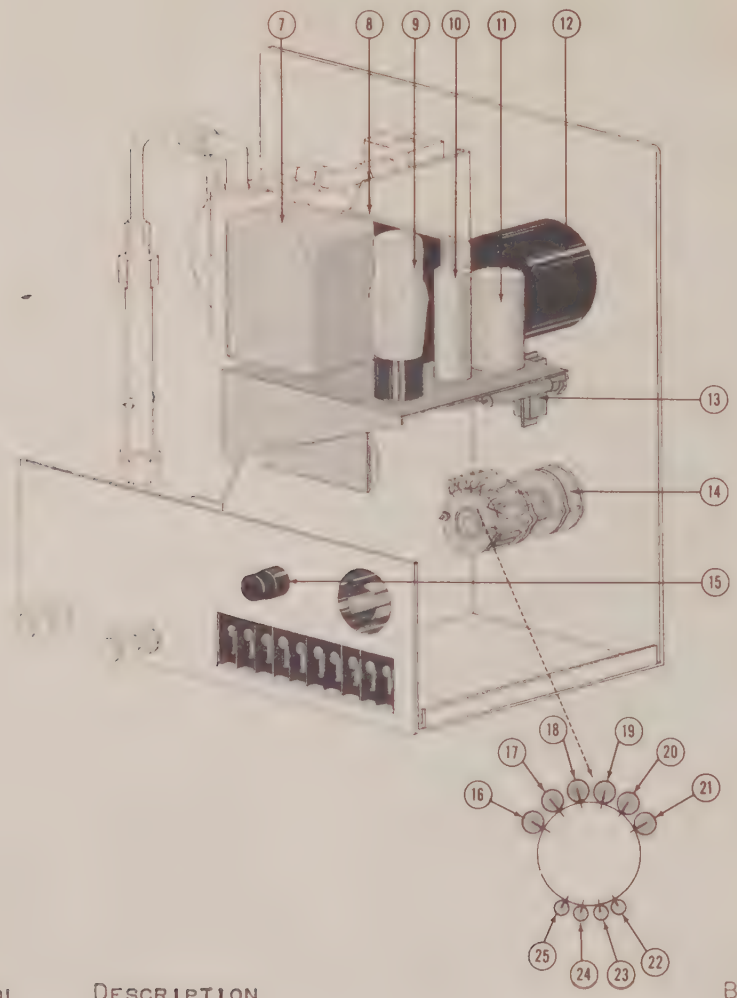
ILLUSTRATED PARTS LIST
17901 ELECTROLYTIC HYGROMETER



No.	Symbol	Description	Beckman Part No.
1		Sample Flowmeter	25341
2		Flow Regulator	25042
3		Bypass Flowmeter	25029
4		*Analyzer Cell Assembly	25047
5		Restrictor Valve	25274
6		Analyzer Cell Filter	25026

*Recommended Spare Part

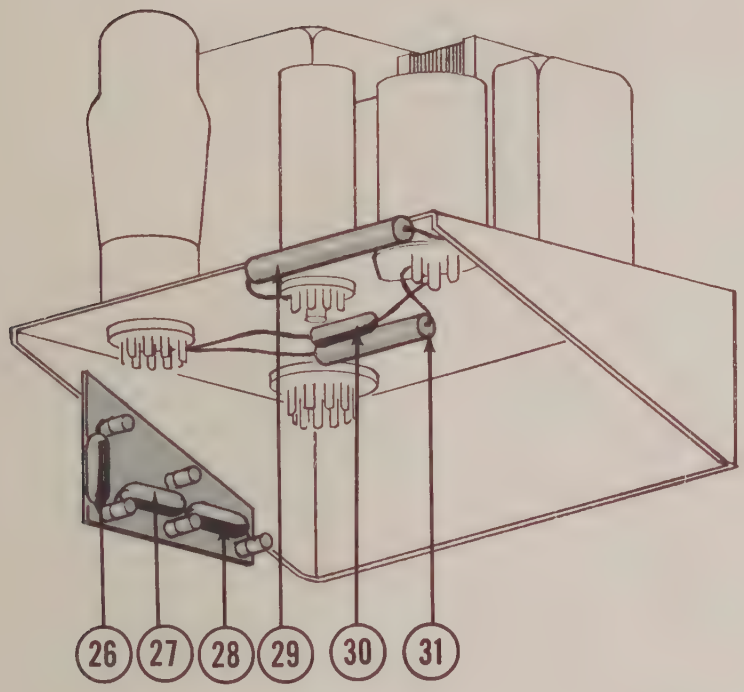
ILLUSTRATED PARTS LIST
17901 ELECTROLYTIC HYGROMETER



No.	Symbol	Description	Beckman Part No.
7		Relay	23365
8		Transformer	23362
9		*Voltage Regulator Tube (RMA 0A3)	23363
10		*Electron Tube (RMA 6X4)	12013
11	C1,C2	Capacitor (10 x 10 mfd)	23364
12		Meter Assembly	25316
13		Alarm Reset Switch	23385
14		Selector Switch Assembly	25039
15		Fuse	8395
16	R17	Resistor (30,000 ohms, 2 watt, ±5%)	20311
17	R16	Resistor (20,000 ohms, 2 watt, ±5%)	23367
18	R15	Resistor (10,000 ohms, 2 watt, ±5%)	15053
19	R14	Resistor (5,100 ohms, 2 watt, ±5%)	91646
20	R13	Resistor (3,600 ohms, 2 watt, ±5%)	23368
21	R12	Resistor (3,600 ohms, 2 watt, ±5%)	23368
22	R11	Resistor (500 ohms, ±1%)	23375
23	R10	Resistor (111 ohms, ±1%)	23374
24	R9	Resistor (34.5 ohms, ±1%)	23373
25	R8	Resistor (10.0 ohms, ±1%)	23372

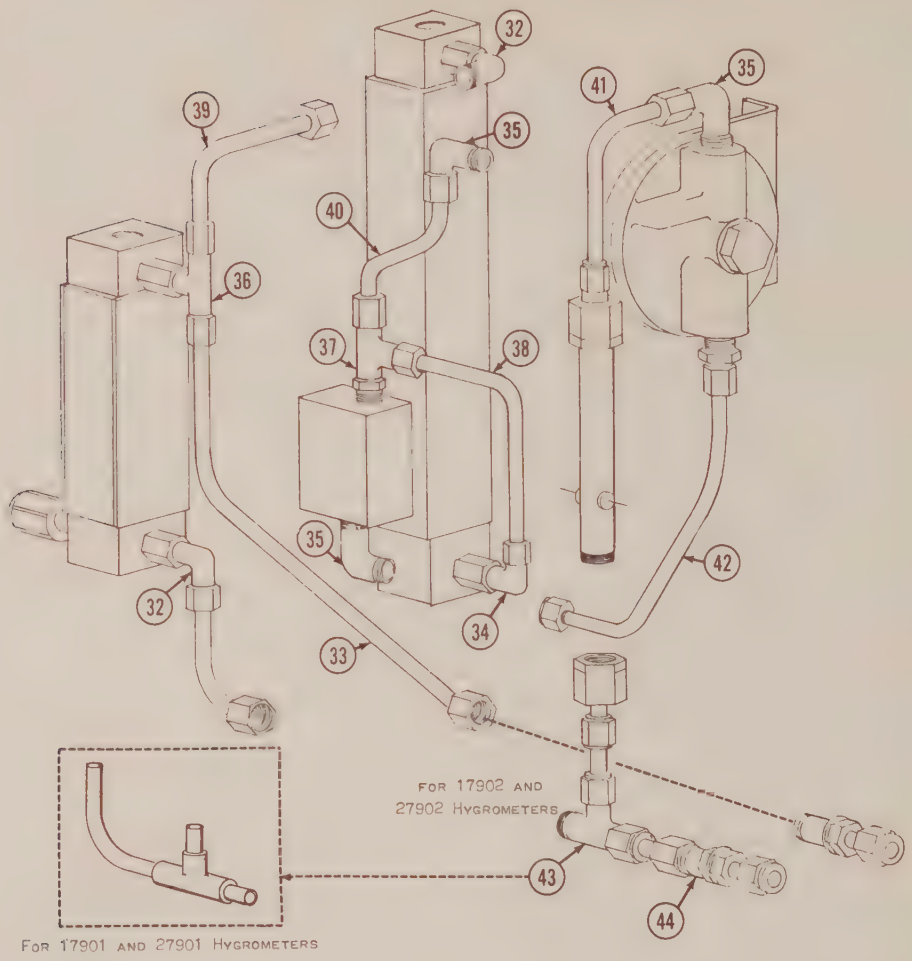
*Recommended Spare Parts.

ILLUSTRATED PARTS LIST
17901 ELECTROLYTIC HYGROMETER



No.	Symbol	Description	Beckman Part No.
26	R5	Resistor (3040 ohms, ±1%)	23369
27	R6	Resistor (1480 ohms, ±1%)	23370
28	R7	Resistor (370 ohms, ±1%)	23371
29	R1	Resistor (510 ohms, 2 watt)	8120
30	C3	Capacitor (0.01 mfd)	15024
31	R2	Resistor (1200 ohms, 5 watts, ±5%)	23366

ILLUSTRATED PARTS LIST
17901 ELECTROLYTIC HYGROMETER



No.	Symbol	Description	Beckman Part No.
32		Elbow	23395
33		Tube	25339
34		Elbow	23981
35		Elbow	17171
36		Tee	23982
37		Tee	23392
38		Tube	25295
39		Tube	25338
40		Tube	25294
41		Tube	25337
42		Tube	25336
43		Tee Assembly	25037
44		Bulkhead Union	23398

PARTS LIST
17902 ELECTROLYTIC HYGROMETER

SAME AS 17901 EXCEPT:

No.	Symbol	Description	Beckman Part No.
1		Sample Flowmeter	25386
2		Flow Regulator	25367
3		Bypass Flowmeter	25387
32		Elbow	23977
33		Tube	25354
34		Elbow	16430
35		Elbow	16429
36		Tee	23978
37		Tee	16428
38		Tube	25353
39		Tube	25352
40		Tube	25350
41		Tube	25351
42		Tube	25349
43		Tee Assembly	16433
44		Bulkhead Union	16432

PARTS LIST
27901 ELECTROLYTIC HYGROMETER

SAME AS FOR 17901 ELECTROLYTIC HYGROMETER

PARTS LIST
27902 ELECTROLYTIC HYGROMETER

SAME AS FOR 17902 ELECTROLYTIC HYGROMETER.